

US LHC Accelerator Project		Baseline Change Request
ECR Number	0005	
WBS	1.0, US LHC Accelerator Project	
Title	Schedule Acceleration	
Change Control Level	2	
Originator	D. Fisher	
Date	15 February 1999	

### **Description of change**

The schedules for all three laboratories were accelerated to “as soon as possible “ within resource constraints such as labor availability. During the process of developing the revised schedules, known work scope and G&A rate changes that affected the cost estimate were included in the change.

### **Reason for change**

The Department of Energy advised the US LHC Accelerator Project Office that the funding profile for the project could be shifted forward to produce a more cost effective program. The opportunity to advance the funding profile was made possible by additional flexibility in the DOE reimbursement of CERN for direct purchases of materials.

### **Impact on other sub-systems**

This change affects all elements at WBS Level 3 as explained below, most through changes in the FY1997 cost estimate and all through the application of escalation at the lowest levels of the WBS.

### **Impact on cost and schedule**

The project’s baseline cost estimate is reduced by \$1.8M and contingency is increased by the same amount. There is no change in the TPC of \$110M.

There is no change to the Level 1 and Level 2 milestones. The Level 3 milestones that were recently put under configuration control were based on the accelerated schedule. The only delivery dates that were accelerated from the original baseline (in the cases of FNAL and LBNL) or the revised baseline after BCR #4 (in the case of BNL) were LBNL’s delivery dates of the DFBs (-16 months), TAN (-13 months), and TAS (-4 months); and BNL accelerating the delivery of the last manufactured magnet by 15 months ( due to a 5 months earlier start combined with a production rate acceleration from 2 magnets every 3 months to 1 magnet per month for the twin aperture magnets). Additional details are discussed under each level 3 WBS.

The previous cost baseline (version 2.0) was the baseline that resulted from the implementation of BCRs 1-4 which were approved in June 1998. At that time escalation was applied only at the total project level due to the difficulty of applying escalation in MS Project. With the entire estimate now loaded into MicroFusion Millennium, which handles escalation much more easily, this BCR for the accelerated baseline (version 3.0) has the escalation applied at the lowest WBS levels. To provide an easy transition from version 2.0

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to version 3.0, the version 3.0 data in Attachment 1 (cost details down to WBS level 4) contain both a FY97\$ column for comparison to version 2.0 and a TY\$ column to show the result with escalation which is the new performance measurement baseline. The changes in escalation can only be compared at the total project level, but can be separated into the escalation change due to the change in the FY97\$ estimate (-114K) and the escalation change due to the accelerated schedule (-214K).

It should be noted here that, in future BCRs, cost comparisons will be made only in TY\$ (the type of dollars that the Congressional cap of \$110M is based on). There will not be backwards comparisons to the constant FY97\$ estimate.

A list of reference files which contain the details of the cost and schedule baselines before and after the change documented in this BCR is given in Attachment 2.

A summarization of the cost and schedule estimate changes at WBS level 3 is as follows:

#### WBS 1.1.1 – IR Quadrupoles

Cost (FY97\$ change: -180K). This downward adjustment is dominated by a reduction in EDIA and tooling maintenance support at FNAL which were shortened consistent with the delivery of the last magnet in November 2003. These reductions were partially offset by corrections of errors made in the application of G&A rates in the original estimates.

Schedule. The delivery schedule for the IR Quadrupoles remained the same; however, the completion of EDIA was changed from 30 Sep 04 to 30 Dec 03.

#### WBS 1.1.2 – IR Dipoles

Cost (FY97\$ change: -19K). There was no change to the prime cost estimate (estimate without G&A). This change is due to the proper application of G&A rates at BNL. BCR #4 recognized that instead of the rates being 34% for the life of the project, they would be 34% for FY96, 45% for FY97, 13.9% for FY98, and 14.8% for the rest of the project. This variation in rates is not easily handled in MS Project (the same problems as handling escalation) and an attempt was made to approximate the variation. With the new estimate now loaded into MicroFusion, the rate calculation is now exact.

Schedule. The earliest material purchases were accelerated from 1 Oct 98 to 1 Jun 98. Materials common to the prototype and D4 RF Dipoles were accelerated to be procured concurrent with the RF Dipole procurements. The order of manufacture was changed from D2-D1-D3-D4 to D4-D2-D3-D1 in order to manufacture similar magnets without interruption, yet still comply with the Level 2 milestones that had previously been established. The rate of production of twin aperture magnets (D2, D3, and D4) was

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increased from 2 to 3 magnets per quarter, while the single aperture D1 production rate was left at its original 1 magnet per month. The D1 production start was slipped by 11 months while D2 production start was accelerated by two months. D2 was able to be accelerated in spite of being changed from first to second in the production order because D4 production was scheduled to start in May 2000 which is 5 months earlier than D2 had originally been scheduled to start (Oct 2000) and also because of the accelerated production rate of one per month. Completion of D1 production was delayed by 7 months (from April 2002 to November 2002), and completion of D2 production was advanced by 4 months (from April 2002 to December 2001).

#### WBS 1.1.3 – IR Cryogenic Feed Boxes

Cost (FY97\$ change: -5K). There was no change to the prime cost estimate. In reviewing the estimate, it was found that some minor errors in the application of G&A rates needed to be corrected.

Schedule. The fabrication time for the boxes was compressed such that the completion of the first feed box was accelerated from May 2002 to August 2001 (9 months) and of the last feed box from April 2003 to Dec 2001 (16 months).

#### WBS 1.1.4 – IR Absorbers

Cost (FY97\$ change: +1K). Essentially no change. This is a rounding error between doing calculations in MS Project and MicroFusion Millennium.

Schedule. The fabrication times for the TAN and TAS were compressed such that the last TAN and last TAS would be shipped in Nov 2002. This is a 13 month acceleration for the TAN and a 4 month acceleration for the TAS. The Ionization Chamber prototype was accelerated 2 months to Jul 2000, but the production chamber was delayed to be as late as possible (Aug 2004) in order to be sure that all modifications resulting from the usage of the prototype at CERN would be able to be incorporated into the production design.

#### WBS 1.1.5 – IR Layout and Integration

Cost (FY97\$ change: -242K). This reduction is due to two changes: 1) the time span of the effort was reduced to be consistent with delivery of the last magnet, and 2) the revised estimate recognized the cost reduction that accrued due to the unexpected resignation of the physicist who had been designated to replace Mike Lamm at CERN. The slot will be vacant for a least a year until a replacement can be named and put in place. 50% of the physicist's time and support was estimated in this WBS.

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Schedule. The completion date was changed from 30 Sep 04 to 30 Dec 03.

#### WBS 1.2.1 – RF Region Dipoles

Cost (FY97\$ change: -106K). There was no change to the prime cost estimate. This change is due to the proper application of G&A rates at BNL as described under WBS 1.1.2.

Schedule. The earliest material purchases were accelerated from 1 Oct 98 to 1 Jun 98. D3 and D4 materials common to the prototypes were accelerated to be procured concurrently with the prototype orders. Prototype manufacturing start was accelerated by 3 months and the duration of the prototype program was compressed by 5 months to realize an 8 month acceleration of the completion of the prototype program. The actual start of production was accelerated only 5 months to allow additional time for data analysis and implementation of changes into the production program. The order of manufacture was changed from D2-D1-D3-D4 to D4-D2-D3-D1. This change and earlier completion of the prototype program accelerated the start of D4 production by 29 months. The rate of production of twin aperture magnets (D2, D3, and D4) was increased from 2 to 3 magnets per quarter. The start of D3 production was accelerated by 8 months thanks to the faster production rate of the preceding magnets. Completion of D3 production was accelerated by 10 months (from April 2003 to June 2002), and completion of D4 production was advanced by 34 months (from February 2004 to April 2001).

#### WBS 1.3.1 – SC Testing

Cost (FY97\$ change: -232K). There was no change to the prime cost estimate. This change is due to the proper application of G&A rates at BNL as described under WBS 1.1.2.

Schedule. No Change

#### WBS 1.3.2 – SC Production Support

(FY97\$ change: +5K). There was no change to the prime cost estimate. This change is due to a correction to an improper G&A rate than had been applied to a resource in a specific task.

Schedule. The CMMs completed delivery in Oct 1997, 22 months earlier than the previous schedule showed.

#### WBS 1.4.1 – BNL Accelerator Physics

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Cost (FY97\$ change: -13K). There was no change to the prime cost estimate. This change is due to the proper application of G&A rates at BNL as described under WBS 1.1.2.

Schedule. No change.

#### WBS 1.5.1 – US LHC Project Office

Cost (FY97\$ change: -65K). Reduction due to the vacant position at CERN as described in WBS 1.1.5. 25% of the physicist's time and support was estimated in this WBS.

Schedule. No change

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#### WBS 1.5.2 – BNL LHC Project Office

Cost (FY97\$ change: -382K). There was no change to the prime cost estimate. This change is due in part to the proper application of G&A rates at BNL as described under WBS 1.1.2. Also, in the Generic Support and Department Administration WBSs, these efforts (estimated as a percent of other BNL effort) were not adjusted for the new time-phasing that resulted from BCR #4, so these efforts are now afforded the full benefit of the new lower rates.

Schedule. No Change

#### WBS 1.5.3 – FNAL LHC Project Office

Cost (FY97\$ change: -105K). Reduction due in part to the vacant position at CERN as described in WBS 1.1.5 (25% of the physicist's time and support). The remaining reduction was due to a reduction of travel in FY04 to coincide with the reduction in EDIA support identified in WBS 1.1.1.

Schedule. No change.

#### WBS 1.5.4 – LBNL LHC Project Office

Cost (FY97\$ change: -2K). Reduction due to a minor correction in the application of G&A rates.

Schedule. No change.

ESCALATION (TY\$ change: -428K). This reduction is divided into two parts: 1) the change due to the net change in the constant FY97\$ cost estimate as described above is –114K, and 2) the change due to the acceleration of the program is –214K.

#### **Other impacts (ES&H, etc.)**

None

#### **Change Control Board recommendation (if required)**

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### Approvals

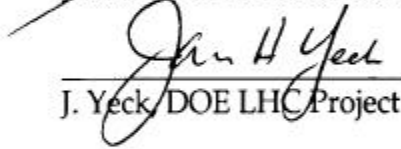
Approved via email  
J. Kerby, FNAL LHC Laboratory Project Manager
26 Feb 99  
Date

Approved via email  
E. Willen, BNL LHC Laboratory Project Manager
8 Mar 99  
Date

Approved via email  
W. Turner, LBNL LHC Laboratory Project Manager
8 Mar 99  
Date

  
J. Strait, Change Control Board Chair
26 Mar 99  
Date

  
J. Strait, US LHC Accelerator Project Manager
26 Mar 99  
Date

  
J. Yeck, DOE LHC Project Manager
26 Mar 99  
Date

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### US LHC Accelerator Project BCR #5 Cost Estimate Changes

		Baseline Version 2.0	Baseline Version 3.0 (Accelerated)		FY97K\$	Explanation
		FY97 K\$	FY97 K\$	TY K\$	Change	
<b>1.1</b>	<b>Interaction Regions</b>	<b>42,147</b>	<b>41,703</b>	<b>44,741</b>	<b>-445</b>	
<b>1.1.1</b>	<b>IR Quadrupoles</b>	<b>26,664</b>	<b>26,484</b>	<b>28,288</b>	<b>-180</b>	
1.1.1.1	Tooling	1,890	1,925	2,000	34	Support reduction (-5), FY96 G&A application (+40)
1.1.1.2	Cold Mass	4,733	4,752	5,104	19	Correction of G&A calculation
1.1.1.3	Cryostat	3,710	3,710	4,113	0	
1.1.1.4	Test	3,086	3,086	3,337	0	
1.1.1.5	Cable and Wedges	1,582	1,582	1,614	0	
1.1.1.6	Shipping	402	402	450	0	
1.1.1.7	EDIA	11,261	11,027	11,671	-233	Reduction in FY04 effort
<b>1.1.2</b>	<b>IR Dipoles</b>	<b>5,509</b>	<b>5,490</b>	<b>5,914</b>	<b>-19</b>	
1.1.2.1	Tooling	162	162	182	0	
1.1.2.2	D1	743	743	797	0	
1.1.2.3	D2	2,689	2,688	2,835	-1	Rounding difference
1.1.2.4	Testing	517	517	578	0	
1.1.2.5	EDIA	1,398	1,380	1,522	-18	Final adjustment for new G&A rates
<b>1.1.3</b>	<b>IR Cryogenic Feed Boxes</b>	<b>4,924</b>	<b>4,920</b>	<b>5,305</b>	<b>-5</b>	
1.1.3.1	Fabrication	3,620	3,620	3,922	0	
1.1.3.2	Shipping	111	115	128	5	Changed G&A category from services to material
1.1.3.3	EDIA	1,194	1,184	1,255	-9	Correction of G&A calculation
<b>1.1.4</b>	<b>IR Absorbers</b>	<b>3,532</b>	<b>3,532</b>	<b>3,843</b>	<b>1</b>	
1.1.4.1	Absorber Fabrication	2,142	2,142	2,351	0	
1.1.4.2	Shipping	137	137	157	0	
1.1.4.3	EDIA	1,253	1,253	1,336	0	
<b>1.1.5</b>	<b>IR Layout and Integration</b>	<b>1,518</b>	<b>1,276</b>	<b>1,392</b>	<b>-242</b>	Task redefinition & inability to fill CERN slot in FY99
<b>1.2</b>	<b>RF straight section</b>	<b>12,636</b>	<b>12,530</b>	<b>13,492</b>	<b>-106</b>	
<b>1.2.1</b>	<b>RF Region Dipoles</b>	<b>12,636</b>	<b>12,530</b>	<b>13,492</b>	<b>-106</b>	
1.2.1.1	Tooling	953	954	1,008	0	
1.2.1.2	Prototypes	277	277	291	0	
1.2.1.3	D3 Production	1,401	1,402	1,499	1	Rounding difference
1.2.1.4	D4 Production	1,969	1,968	2,071	-1	Rounding difference
1.2.1.5	Testing	960	960	1,045	0	
1.2.1.6	EDIA	7,075	6,969	7,579	-106	Final adjustment for new G&A rates
<b>1.2.2</b>	<b>(Reserved)</b>					



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		Baseline Version 2.0	Baseline Version 3.0 (Accelerated)		FY97K\$	Explanation
		FY97 K\$	FY97 K\$	TY K\$	Change	
<b>1.3</b>	<b>SC wire and cable</b>	<b>10,608</b>	<b>10,380</b>	<b>11,352</b>	<b>-228</b>	
<b>1.3.1</b>	<b>SC testing</b>	<b>9,511</b>	<b>9,278</b>	<b>10,218</b>	<b>-232</b>	
1.3.1.1	Tooling & Equipment	868	796	839	-72	Final adjustment for new G&A rates
1.3.1.2	Tests	4,820	4,800	5,399	-19	Final adjustment for new G&A rates
1.3.1.3	EDIA	3,101	2,961	3,259	-141	Final adjustment for new G&A rates
1.3.1.4	FY1996 Actual Costs	722	722	722	0	
<b>1.3.2</b>	<b>SC cable prod'n support</b>	<b>1,097</b>	<b>1,102</b>	<b>1,134</b>	<b>5</b>	
1.3.2.1	Dipole Cable R&D	389	389	400	0	
1.3.2.2	Cable meas support	458	463	470	5	Changed G&A category from services to material
1.3.2.3	Cable mfg support	47	47	48	0	
1.3.2.4	EDIA	203	203	216	0	
<b>1.4</b>	<b>Accelerator Physics</b>	<b>4,508</b>	<b>4,495</b>	<b>4,925</b>	<b>-13</b>	
1.4.1	BNL Accelerator Physics	1,788	1,775	1,956	-13	Final adjustment for New G&A rates
1.4.2	FNAL Accelerator Physics	1,525	1,525	1,654	0	
1.4.3	LBNL Accelerator Physics	1,195	1,195	1,315	0	
<b>1.5</b>	<b>Project Management</b>	<b>14,175</b>	<b>13,621</b>	<b>14,907</b>	<b>-554</b>	
<b>1.5.1</b>	<b>US LHC Project Ofc</b>	<b>3,194</b>	<b>3,129</b>	<b>3,439</b>	<b>-65</b>	
1.5.1.1	EDIA	2,720	2,655	2,921	-65	Inability to fill vacant CERN slot in FY99
1.5.1.2	Travel	326	326	355	0	
1.5.1.3	Miscellaneous	149	149	164	0	
<b>1.5.2</b>	<b>BNL LHC Project Ofc</b>	<b>6,723</b>	<b>6,341</b>	<b>6,930</b>	<b>-382</b>	
1.5.2.1	EDIA	1,753	1,733	1,905	-21	Final adjustment for new G&A rates
1.5.2.2	Travel	696	685	750	-11	Final adjustment for new G&A rates
1.5.2.3	Generic Support	1,693	1,581	1,722	-112	Time-phasing change & final adjustment for new G&A
1.5.2.4	Department Admin	2,484	2,246	2,456	-238	Time-phasing change & final adjustment for new G&A
1.5.2.5	FY96 Actuals	97	97	97	0	
<b>1.5.3</b>	<b>FNAL LHC Project Ofc</b>	<b>2,271</b>	<b>2,166</b>	<b>2,373</b>	<b>-105</b>	
1.5.3.1	EDIA	1,693	1,628	1,783	-65	Inability to fill vacant CERN slot in FY99
1.5.3.2	Travel	560	520	570	-40	Reduction in FY04 travel
1.5.3.3	Miscellaneous	19	19	20	0	
<b>1.5.4</b>	<b>LBNL LHC Project Ofc</b>	<b>1,986</b>	<b>1,984</b>	<b>2,165</b>	<b>-2</b>	
1.5.4.1	EDIA	1,063	1,063	1,173	0	
1.5.4.2	Travel	682	682	747	0	
1.5.4.3	Miscellaneous	241	239	245	-2	Minor correction in G&A
	<b>Total (FY1997 dollars)</b>	<b>84,074</b>	<b>82,728</b>	<b>NA</b>	<b>-1,346</b>	Total for FY97\$ changes
	<b>Escalation</b>	<b>7,117</b>	<b>6,689</b>	<b>NA</b>	<b>-428</b>	-114 due to FY97\$ changes, -314 due to acceleration
	<b>Total (then-year dollars)</b>	<b>91,191</b>	<b>89,417</b>	<b>89,417</b>	<b>-1,774</b>	Total reduction in baseline cost
	<b>Contingency</b>	<b>18,809</b>	<b>20,583</b>	<b>20,583</b>	<b>1,774</b>	Total increase in contingency. Contingency as a % of budget to go (BAC-BCWP) is 30% as of 31 Dec 98
	<b>Total Project Cost</b>	<b>110,000</b>	<b>110,000</b>	<b>110,000</b>		

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### **List of files defining the old and new baselines**

All files reside in TDPC01.fnal.gov\TDNT\_Server\US-LHC(admin)\

#### Baseline V2.0

Cost estimate in FY1997 dollars:

CE\_V2.0\BNL\ 112\_IR\_Dipoles.xls  
121\_RF\_Dipoles.xls  
131\_sctest.xls  
141\_AP\_BNL.xls  
152\_PM.xls  
CE\_V1.0\FNAL\111\_IRQ\_Tooling.xls  
1112\_IRQ\_Coldmass.xls  
1113\_IRQ\_Cryostat.xls  
1114\_IRQ\_Test.xls  
1116\_Shipping.xls  
1117\_IRQ\_EDIAv03.xls  
115\_IR\_SystemInt.xls  
14\_AP\_FNAL.xls  
15\_ProjMgmt.xls  
CE\_V1.0\LBNL\1115\_IRQ\_LBNL.xls  
113\_IR\_Feed\_Boxes\_ae.xls  
114\_IR\_Absorbers\_ae.xls  
132\_SC\_Cable\_Prod\_Support\_ae.xls  
143\_AP\_LBNL.xls  
154\_PM\_LBNL\_AE.xls

Schedule:

Schedules\BNL\Baseline\BNL Baseline v2.0.doc\*  
CE\_V1.0\FNAL\fnal009.mpp  
Schedules\LBNL\Baseline\LBNL Baseline v1.0.mpp

\*This is a summary schedule display which was included in BCR#4. A complete MS Project schedule was never developed at this level as work on the accelerated baseline (this BCR) had already begun at the time of the approval of BCR#4.

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#### Baseline V3.0

Cost estimate in FY1997 dollars and schedule:

Schedules\BNL\Baseline\BNL Baseline v3.0.mpp

Schedules\FNAL\ Baseline\FNAL Baseline v3.0.mpp

Schedules\LBNL\ Baseline\LBNL Baseline v3.0.mpp

Cost estimate in Then Year dollars

Cost\_Estimate\Ce\_v3.0\BNL \1.1.2 IR Dipoles.PDF

1.2.1 RF Dipoles.PDF

1.3.1 SC Testing.PDF

1.4.1 Accel Physics.PDF

1.5.2 Pgm Mgt.PDF

BNL Summary.PDF

Cost\_Estimate\Ce\_v3.0\FNAL\1.1.1.1 Tooling.PDF

1.1.1.2 Cold Mass.PDF

1.1.1.3 Cryostat.PDF

1.1.1.4 Test.PDF

1.1.1.6 Shipping.PDF

1.1.1.7 EDIA.PDF

1.1.5 Sys Design.PDF

1.4.2 Accel Physics.PDF

1.5 Pgm Mgt.PDF

FNAL Summary.PDF

Cost\_Estimate\Ce\_v3.0\LBNL\1.1.1 Quad cable & Wedges.PDF

1.1.3 Cryo Feedboxes.PDF

1.1.4 Absorbers.PDF

1.3.2 Cable Prod Supt.PDF

1.4.3 Accel Physics.PDF

1.5.4 Proj Mgt.PDF

LBNL Summary.PDF